

Improving Girls' Math Identity through Problem-solving and Mentorship



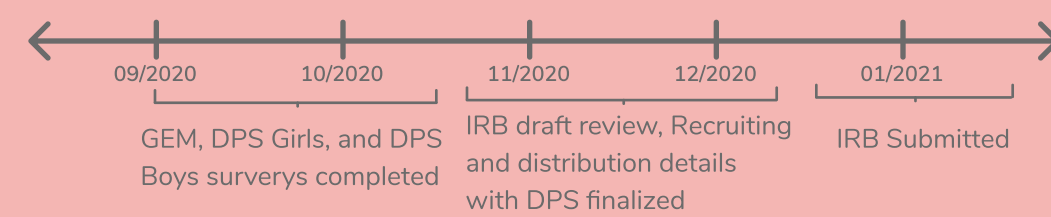
Dr. Sophia Santillan¹, Dr. Victoria Akin²

Graduate Students: Leah Metcalf

Undergraduate Students: Samantha Dilley, Morgan Feist, Julia Helm, Sydney Hunt, Tayla Jeter, Tess Lipsky, Naomi Rubin, Miryam Rudolph, Ann Sawers, Anna Song, Caroline Tang, Michelle Yin

Study Design

The Study Design team revised and edited the past two years of pre and post surveys given to GEM participants to create a DPS district wide 2021 survey, as well as a specific version to past workshop attendees. These surveys were designed to identify how boys and girls varied in their approach, confidence, and perspective with regards to math. The team also created a pre-testing round utilizing the mentors network to ensure the survey was appropriate for middle schoolers.



Applet Design

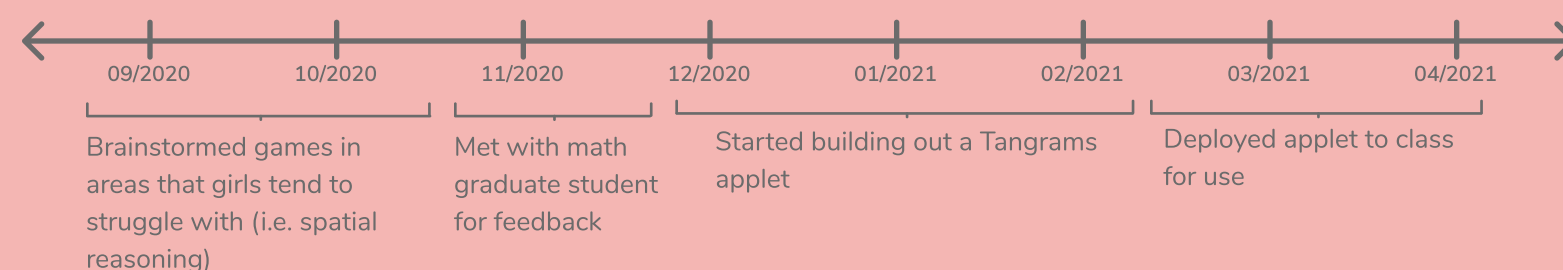
The applet team focused on creating a digital applet accessible to middle-school girls in the GEM program that:

1. Helped them develop spatial reasoning and mental rotation skills
2. Provides questions to work on basic algebra, geometry and fraction problems
3. Is available during Covid-19
4. Is age-appropriate and user-friendly
5. Builds confidence and resilience in math

After researching on various skills that are helpful when learning and understanding math, the team decided on designing a tangram-based game, with reinforcement and helpful tips to throughout the puzzles to ensure girls would be motivated, not discouraged as they completed the levels.

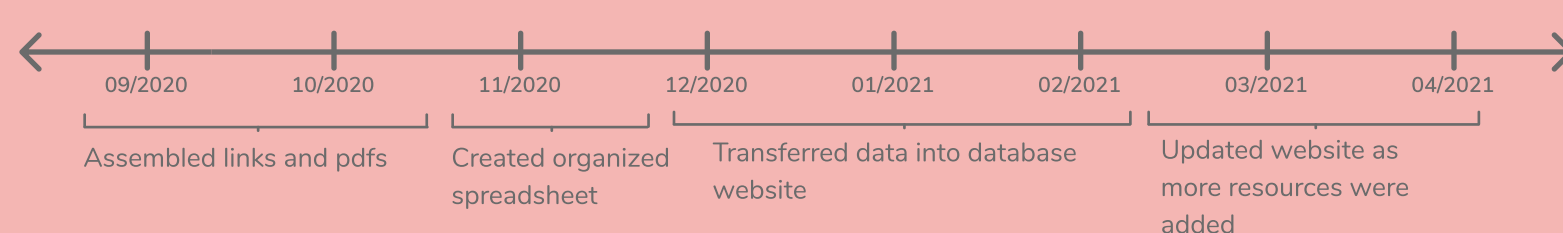


Screenshot of applet. Students are prompted to create the black shape using the available tangrams



Literature Review

The Literature Review team produced a public database full of published papers and research about the gender gap, STEM inequality, stereotype threat, female representation in STEM, and spatial reasoning skills, among others. With over 50 papers analyzed, they provided a brief description of each paper, key words, and specific notes on how it could help the other GEM research teams with their own projects.



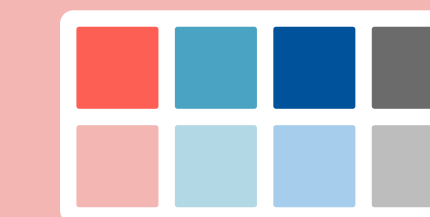
Background: The Need for GEM

- Women are still underrepresented in upper levels of educational and professional attainment in STEM.
- In primary and secondary education:
 - Girls and boys score equally on standardized math tests in 4th grade.
 - Girls take fewer AP exams in STEM subjects such as calculus, physics, computer science, and chemistry than boys in high school
- Overall, **24%** of people in STEM careers are women.

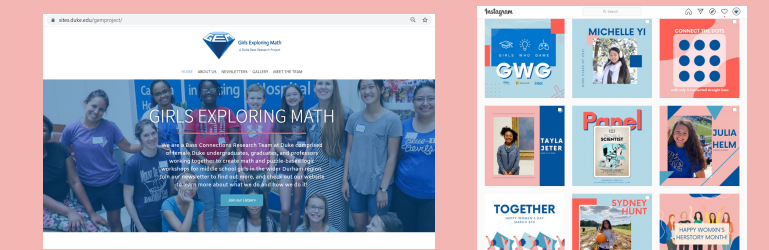
How COVID-19 Changed GEM

Normal Year	COVID-19 Year
<ul style="list-style-type: none"> • Workshops for young women to explore math from Jan-Apr • Problem-based math activities guided by 2 mentors <ul style="list-style-type: none"> • Discussions about cultural factors known to influence students' identities including stereotype threat, gender norms, and beliefs about intelligence (fixed vs. growth mindset). • Changes in math ability and mindset following the workshops are assessed through pre- and post-tests. 	<ul style="list-style-type: none"> • Restrictions on in-person interactions led to transition to smaller mini projects • Specialized teams with different focuses • Team results established foundational measures for: <ul style="list-style-type: none"> • Social Media • Website • Applet, • Data analysis

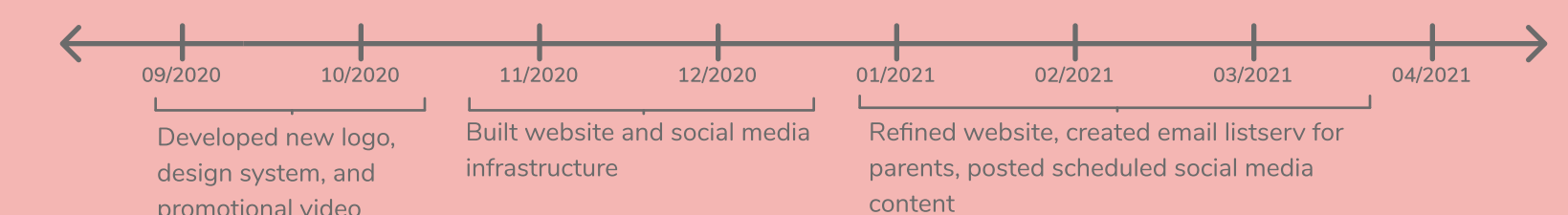
Social Media and Marketing



Color palette and Logo



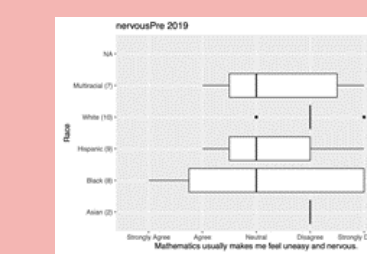
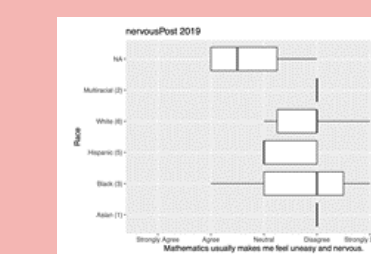
Screenshots of the website and Instagram



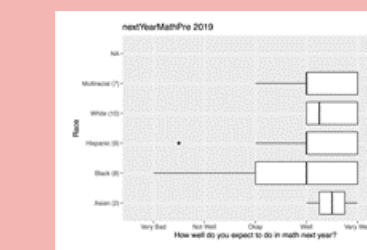
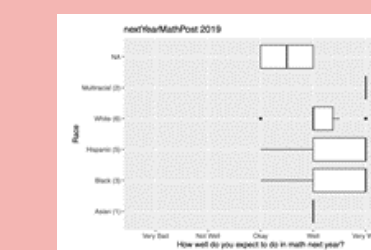
Data Analysis

Utilizing 2019 and 2020 Survey Data, the Data Analysis team analyzed responses to investigate the impact of GEM workshops on middle school girls.

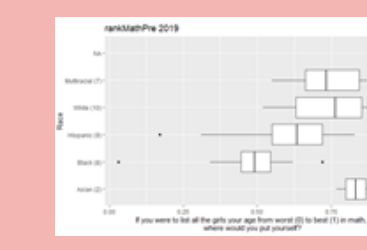
Research Question: Among GEM participants in 2019, do indicators of math confidence increase after attending the workshops?



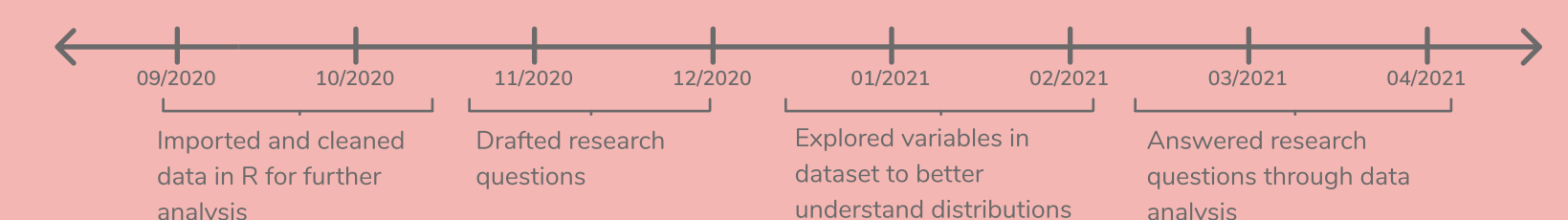
When asked if mathematics made them feel uneasy or nervous, everyone's confidence in math either increased or stayed the same. There was a general improvement in the way people felt about math after the workshops.



When asked how well they expect to do in math next year, every student's confidence increased except for white girls. Black girls went from believing they would do very badly to doing okay.



When asked how they compare themselves to their peers in math, everyone increased in confidence.



Lesson Plan Archive

The Lesson Plan Archive Team worked on reviewing six lessons from 2019 and streamlining the STEM-content to be pedagogically coherent. Through focusing on making the plan constructivist, clearly sequenced, hands-on, and with clear real-world applications, these workshops could become more effective for middle school girl attendees.

A typical lesson plan template included:

1. Title
2. Materials
3. Estimated Time
4. Learning Standards (pulled from NC Education System)
5. Introduction of main concept/problem
6. Analyzing Data to understand/solve concept/problem
7. Closing reflections
8. Take home activities